# AIR QUALITY STUDIES
# in the vicinity of
# ERCO INDUSTRIES LIMITED,
# THUNDER BAY

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June, 1983

## INTRODUCTION

ERCO Industries Limited of Thunder Bay manufactures sodium chlorate, a chemical used to manufacture bleaching agents for the kraft pulp industry. In late 1981, following a complaint concerning alleged vegetation damage near ERCO, the Ministry of the Environment undertook an investigation. A snow sampling survey was carried out early in 1982, followed by vegetation sampling and a moss exposure experiment in the 1982 growing season. Standard Ministry sampling procedures (1) were used throughout the survey. Barium and chloride sample analysis was performed at the Ministry's laboratory in Toronto. All other analyses were carried out at the Ministry's Thunder Bay laboratory.

## SNOW SAMPLING

Duplicate snow samples were collected on January 19-20, 1982 from 13 sites surrounding the ERCO property (Figure 1). Sample core depth ranged from 34-65 cm, and averaged approximately 53 cm. Each sample was analyzed for barium, calcium, chloride, chromium, magnesium and sodium, all of which are elements associated with production processes at ERCO. Analytical results are shown in Table 1. Sodium and chloride concentrations at sites 6, 7 and 9 were slightly higher than normal background levels, probably because of contamination from City Road. None of the other elements were elevated at any of the sampling points.

## VEGETATION ASSESSMENT

A vegetation inspection survey was conducted around ERCO's plant on October 21, 1981. No visible damage to coniferous trees was apparent. The possibility of injury to deciduous trees could not be determined at that time because all broadleaved vegetation was dormant.

An examination of vegetation surrounding the plant property was carried out on June 16, 1982. Balsam poplar ( Populus balsamifera) and trembling aspen ( Populus tremuloides) trees growing east and north of ERCO's perimeter fence showed signs of severe dieback, with up to half their crowns dead. Standing water up to 40 cm in depth was encountered in the area shaded on Figure 2. We observed no significant foliar damage attributable to insects, disease, or symptoms of air pollution injury.

On August 3-4, 1982, balsam poplar and speckled alder (Alnus rugosa) foliage was collected from 17 sites around ERCO's plant. All samples were analyzed for the same elements as snow. Results (Table 2) indicate that, compared to control samples, chloride was elevated at sites 7, 8 and 9. Sodium concentrations declined slightly as sampling distance from ERCO increased (Figure 3), but levels at both the ERCO and control sites were within the range considered normal. Concentrations of all other elements were also normal.

On January 26, 1983, cores of stemwood were obtained from four mature balsam poplar trees located immediately east of ERCO's fence line. Two of these trees were dead. Growth rings in the cores showed that there had been a gradual decrease in the diameter growth rate over the past 20 to 25 years. There was no indication of a sudden decline in growth in the past few years.

## MOSS EXPOSURE

Samples of Sphagnum moss were exposed from June 16 to August 4, 1982, at the same sites where vegetation was sampled. Analyses of exposed moss (Table 3) showed that the same elements studied in snow and vegetation were present at normal background concentrations.

## CONCLUSION

Our study showed that the decline of trembling aspen and balsam poplar trees around ERCO could not be attributed to airborne contaminants from this source.

Chemical analyses of snow, tree foliage and exposed moss confirmed that concentrations of all elements examined were within normal ranges.

Aerial photographs taken in 1975 showed that the ERCO site was initially a low, poorly drained area. The natural drainage pattern may have been altered when plant construction began in April, 1978. Approximately a metre of fill was added in the plant area to ensure a stable building site. The raised railway and road beds to the north and south of ERCO may have further impeded natural drainage. We believe that flooding which preceded or followed the construction of the plant was the cause of decreased growth and death of many of the trees nearby.

## REFERENCE

1. Ontario Ministry of the Environment. 1983. Field Investigation Procedures Manual. Phytotoxicology Section, Air Resources Branch.

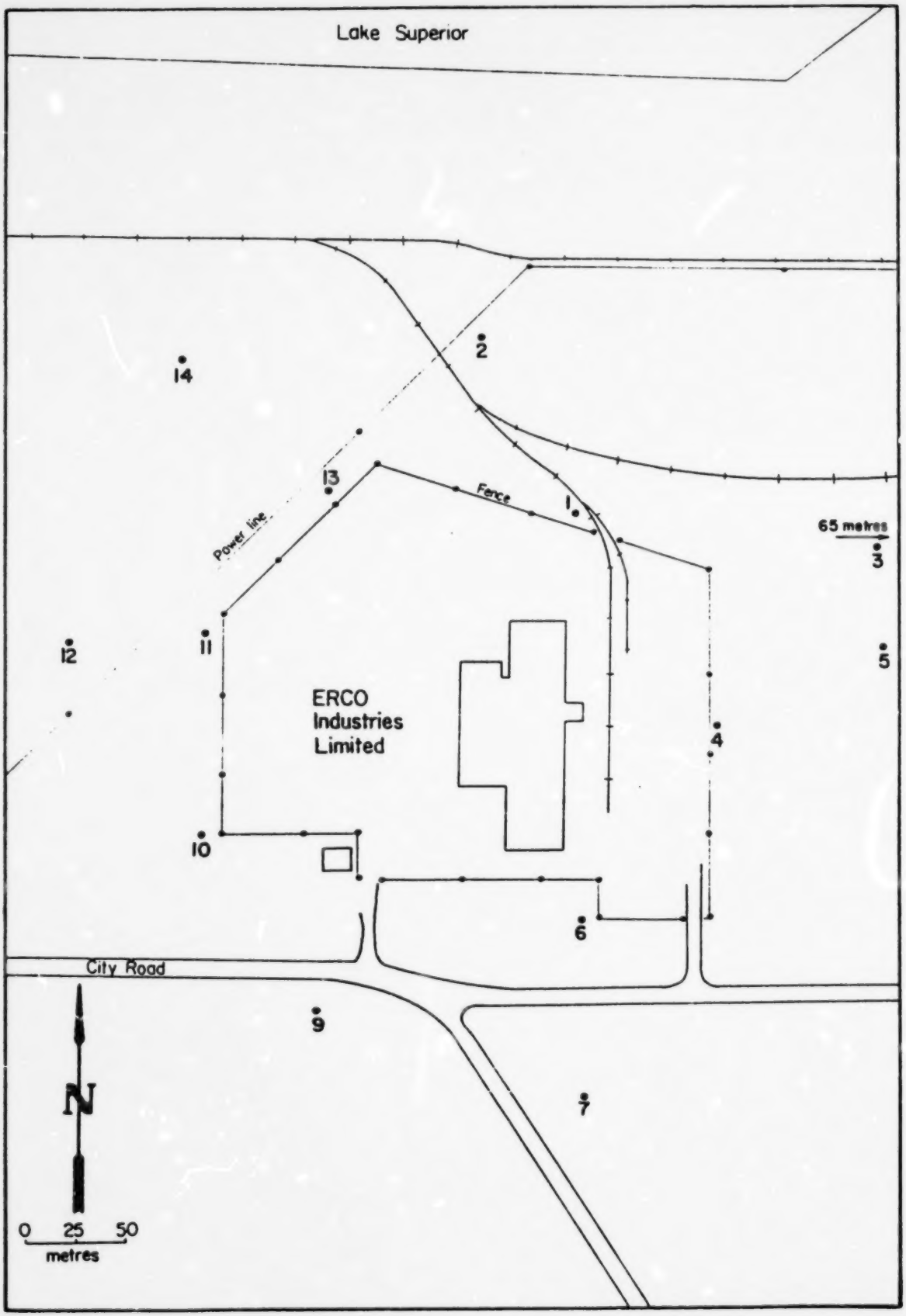


Figure 1. Snow sampling sites, ERCO Industries Limited, Thunder Bay, January 19, 1982.

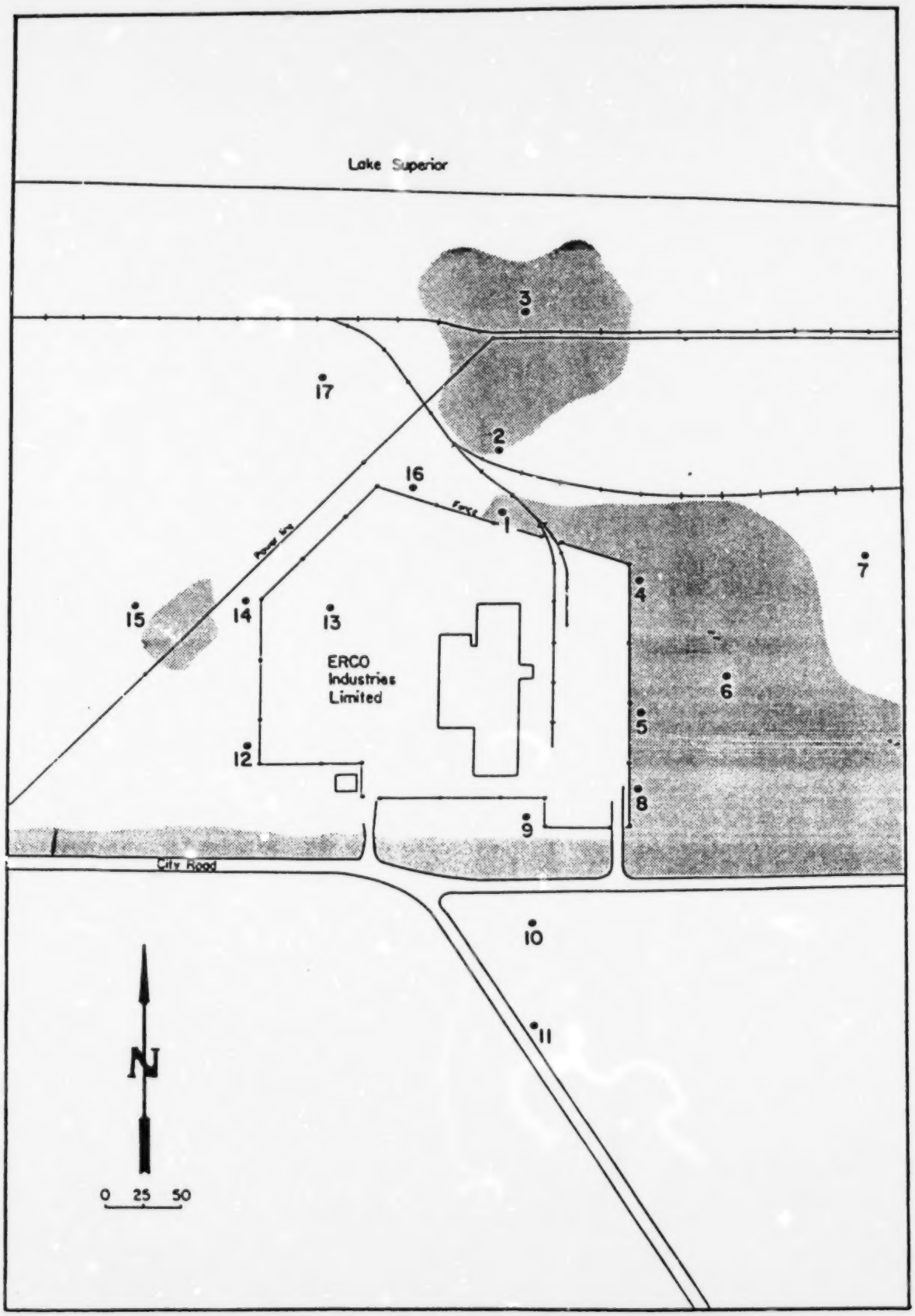


Figure 2. Moss exposure and vegetation sampling sites, ERCO Industries Limited, 1982.

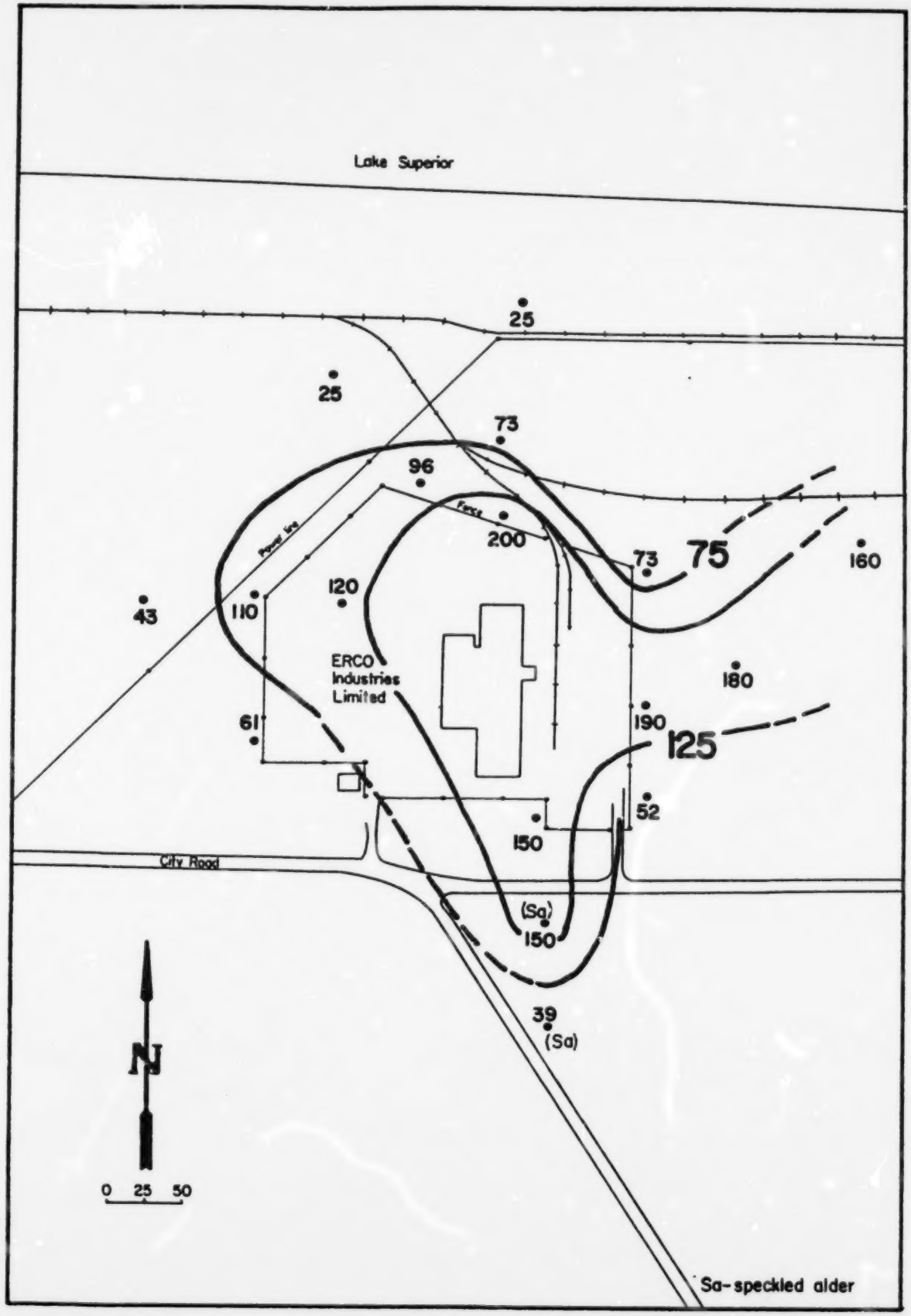


Figure 3. Levels of sodium (µg/g) in balsam poplar, ERCO, 1982.

TABLE 1. Levels of selected elements (in mg/ℓ) and pH in meltwater from snow sampled in the vicinity of ERCO Industries Limited, Thunder Bay, January 19-20, 1982

| Station | Barium | Calcium | Chloride | Chromium | Magnesium | Sodium | pH |
|---|---|---|---|---|---|---|---|
| 1 | 0.019 | 0.74 | 1.0 | 0.001 | 0.09 | 1.40 | 5.0 |
| 2 | 0.021 | 0.60 | 0.6 | <0.001 | 0.09 | 0.52 | 5.5 |
| 3 | 0.022 | 0.77 | 0.8 | 0.002 | 0.07 | 0.72 | 5.6 |
| 4 | 0.016 | 0.59 | 1.6 | 0.001 | 0.08 | 1.90 | 5.5 |
| 5 | 0.022 | 0.92 | 1.0 | 0.002 | 0.12 | 1.20 | 4.4 |
| 6 | 0.039 | 1.20 | 5.2 | 0.008 | 0.09 | 3.50 | 5.7 |
| 7 | 0.032 | 1.10 | 12.0 | 0.004 | 0.05 | 7.70 | 5.5 |
| 9 | 0.024 | 0.66 | 6.2 | 0.002 | <0.05 | 4.40 | 5.8 |
| 10 | 0.028 | 0.76 | 0.7 | 0.003 | 0.06 | 0.60 | 4.9 |
| 11 | 0.026 | 0.91 | 0.5 | 0.004 | 0.06 | 0.50 | 5.5 |
| 12 | 0.024 | 0.74 | 0.6 | 0.005 | 0.08 | 0.60 | 5.2 |
| 13 | 0.022 | 0.78 | 0.4 | 0.002 | 0.08 | 0.60 | 5.2 |
| 14 | 0.028 | 0.98 | 0.8 | 0.002 | 0.09 | 0.70 | 5.6 |
| Control | 0.006 | <0.20 | 0.2 | 0.001 | <0.05 | <0.1 | 4.2 |
| Normal background | | <5.0 | <5.0 | - | <5.0 | <5.0 | - |

TABLE 2. Levels of selected elements (µg/g, dry weight) in unwashed balsam poplar and speckled alder foliage collected near ERCO Industries Limited, Thunder Bay, August 4, 1982.

| Station | Foliage sampled[a] | Barium | Calcium | Chloride | Chromium | Magnesium | Sodium |
|---|---|---|---|---|---|---|---|
| 1 | Bp | 5 | 9900 | 0.22 | <2.0 | 4800 | 200 |
| 2 | Bp | 4 | 14000 | 0.13 | <2.0 | 4600 | 73 |
| 3 | Bp | 7 | 14000 | 0.12 | 2.0 | 5100 | <25 |
| 4 | Bp | 2 | 9200 | 0.11 | <2.0 | 4500 | 73 |
| | Sa | 20 | 8400 | 0.21 | <2.0 | 3400 | 73 |
| 5 | Bp | 8 | 7900 | 0.21 | <2.0 | 4100 | 190 |
| | Sa | 6 | 6600 | 0.35 | 2.0 | 2700 | 200 |
| 6 | Bp | 4 | 9000 | 0.25 | <2.0 | 3400 | 180 |
| | Sa | 6 | 9100 | 0.22 | <2.0 | 2300 | 73 |
| 7 | Bp | 3 | 8500 | 0.12 | <2.0 | 4300 | 160 |
| | Sa | 11 | 8100 | 0.57 | <2.0 | 2700 | <25 |
| 8 | Bp | 2 | 6000 | 0.16 | <2.0 | 3500 | 52 |
| | Sa | 10 | 12000 | 0.51 | <2.0 | 5300 | <25 |
| 9 | Bp | 12 | 14000 | 0.09 | <2.0 | 2400 | 150 |
| | Sa | 14 | 13000 | 0.66 | <2.0 | 3700 | 73 |
| 10 | Sa | 17 | 8100 | 0.21 | <2.0 | 2000 | 150 |
| 11 | Sa | 13 | 8800 | 0.09 | <2.0 | 1800 | 39 |
| 12 | Bp | 5 | 13000 | 0.13 | 5.5 | 4400 | 61 |
| | Sa | 4 | 9300 | 0.29 | <2.0 | 2800 | <25 |
| 13 | Bp | 12 | 15000 | 0.13 | <2.0 | 2000 | 120 |
| 14 | Bp | 8 | 19000 | 0.12 | <2.0 | 3800 | 110 |
| 15 | Bp | 5 | 10000 | 0.09 | <2.0 | 3300 | 43 |
| | Sa | 15 | 8700 | 0.09 | <2.0 | 2200 | 39 |
| 16 | Bp | 10 | 17000 | 0.11 | <2.0 | 3400 | 96 |
| 17 | Bp | 4 | 21000 | 0.06 | <2.0 | 2700 | <25 |
| Control | Bp | 11 | 12000 | 0.01 | <2.0 | 3500 | <25 |
| Control | Sa | 28 | 10000 | 0.06 | <2.0 | 3300 | <25 |
| Normal background | - | - | - | - | <10 | - | <600 |

[a]Bp = Balsam poplar.

Sa = Speckled alder.

TABLE 3. Concentrations of selected elements (in µg/g, dry weight) in Sphagnum moss exposed from June 16 to August 4, 1982 near ERCO Industries Limited, Thunder Bay.

| Station | Barium | Calcium | Chloride | Chromium | Magnesium | Sodium |
|---|---|---|---|---|---|---|
| 1 | 32 | 5700 | .02 | 3.0 | 1300 | 240 |
| 2 | 41 | 6200 | .03 | <2.0 | 1500 | 180 |
| 3 | 30 | 4300 | .03 | 5.0 | 1300 | 230 |
| 4 | 19 | 4000 | .01 | 3.5 | 1300 | 180 |
| 5 | 28 | 5700 | .02 | 3.5 | 1400 | 350 |
| 6 | 27 | 5100 | .02 | 3.5 | 1400 | 220 |
| 7 | 32 | 5800 | .02 | 5.5 | 1500 | 290 |
| 8 | 29 | 5200 | .02 | 3.5 | 1400 | 240 |
| 9 | 27 | 5500 | .02 | 2.5 | 1400 | 220 |
| 10 | 38 | 6100 | .02 | 3.0 | 1600 | 300 |
| 11 | 24 | 5200 | .06 | 3.5 | 1500 | 390 |
| 12 | 18 | 4900 | .04 | 3.0 | 1600 | 140 |
| 13 | 33 | 6400 | .02 | 4.5 | 1700 | 260 |
| 14 | 24 | 5000 | .02 | <2.0 | 1400 | 280 |
| 15 | 20 | 5000 | .02 | 2.0 | 1400 | 220 |
| 16 | 42 | 7100 | .02 | 4.0 | 1500 | 250 |
| 17 | 26 | 4600 | .02 | 3.0 | 1300 | 240 |
| Exposed control | 28 | 5300 | .03 | 4.8 | 1400 | 200 |
| Unexposed control | 20 | 6600 | .02 | <2.0 | 1300 | 60 |